

9. The program had proved to be a good public relations project and, as a result, has improved the status of the health department in the community.

It is the plan of the city health department to have the entire downtown area ratproofed and freed of rats (as far as practicable) by January 1952.

"Salmonella" Food Poisoning

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Salmonella has been known to be associated with food poisoning since shortly after Salmon and Smith (1885) first described a member of the group. Early workers attempted to classify the *Salmonella* into the following three groups (5) according to pathogenicity and host specificity: (1) those organisms that are of human origin and are pathogenic for man only; (2) those of animal origin and non-pathogenic for man; (3) those of animal origin, and primarily infecting animals but also causing a mild gastro-enteritis in man. In recent years, the use of newer selective media for the isolation of *Salmonella* and more adequate antigenic analysis of these organisms have disclosed the infection of humans with the "purely animal" strains, and the infection of animals with "purely human" strains. Of the more than 150 antigenic types of *Salmonella* now recognized, few, if any, are limited to one host (2). All types must be considered as potential pathogens for man and/or animals.

Hormaeche and his associates (29,30) observed that the clinical syndrome produced in persons contracting *Salmonella* infection depends largely upon the age and general resistance of the individual and to a lesser extent upon the type of *Salmonella*. Thus infants and young children are most susceptible to *Salmonella* infection. Edwards, Bruner, and Moran (10) have noted a greater susceptibility to *Salmonella* infections in young animals.

The accepted differentiation of the various clinical manifestations of salmonellosis (25) may be described as: (1) *Salmonella* fever, a mild febrile illness; (2) *Salmonella* septicemia, remittent fever, more severe with localization of infection in various tissues in later stages; (3) *Salmonella* gastro-enteritis (food poisoning), the most common

form; (4) extraintestinal infections (localized), such as cholecystitis, osteomyelitis, and otitis; and (5) the normal carrier state.

A few *Salmonella* types appear to be involved predominantly in certain forms of salmonellosis. For instance, *Salmonella paratyphi A* and *Salmonella cholerae-suis* occur more frequently in *Salmonella* fever and septicemia, the latter type being fatal in many cases; *Salmonella typhimurium* and *Salmonella newport* more commonly cause gastro-enteritis; and *Salmonella pullorum* is primarily the cause of an infection of fowl. However, all types should be considered as capable of causing food poisoning. In general, the incubation period is from 12 to 36 hours. Onset of illness is sudden, accompanied by vomiting, diarrhea, abdominal pain, fever, and sometimes prostration. The duration is seldom longer than 3 to 4 days. *Salmonella* food poisoning is considered a type of infection, i. e., the illness is caused by the multiplication of the organism in the intestinal tract rather than by the ingestion of preformed toxins (8). The belief that a "toxin" type of *Salmonella* food infection occurs was proposed by Savage (cited by Dolman) (9) when *Salmonella* could not be isolated from suspected food or from the patient in outbreaks of food poisoning in which the incubation period was short. Numerous experiments involving the feeding of filtrates or heat-killed *Salmonella* cultures to animals and human volunteers have been conducted. These studies have failed to demonstrate the existence of preformed *Salmonella* toxins.

INCIDENCE OF "SALMONELLA" GASTRO-ENTERITIS

Definite data concerning the incidence of *Salmonella* food poisoning in the United States are not available due to the many unreported sporadic cases. These cases usually are mild and are of

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short duration. Thus statistics regarding incidence must be based upon large outbreaks that come to the attention of physicians, public health authorities, and *Salmonella* typing centers. Dolman (9) states that *Salmonella* food poisoning probably is more prevalent in Great Britain than in North America. Conybeare, Allison, and Taylor (7) have shown the actual numbers of outbreaks of food poisoning (*Salmonella* and otherwise) reported to the Ministry of Health during a 20-year period (1927-47). According to their figures, more than 75 percent of the outbreaks were due to *Salmonella*. From 1927 to 1942, not more than 100 outbreaks of *Salmonella* food poisoning per year were reported. Since 1942 the incidence in England has increased rapidly to more than 650 outbreaks in 1947.

Hobbs (28) reported that of 3,495 incidents of food poisoning investigated by the Public Health Laboratory Service in England from 1941 to 1948, approximately 91 percent were caused by organisms of the *Salmonella* group.

Rubenstein, Feemster, and Smith (40) report the occurrence of 356 epidemic cases in 17 outbreaks in Massachusetts. Valuable information regarding the occurrence and distribution of *Salmonella* in the United States was presented by Edwards, Bruner, and Moran (11) in a report of results obtained in typing 12,331 cultures isolated from man and from domestic and wild animals during the period 1934 to 1947. Similarly, Seligmann, Saphra, and Wasserman (44) reported 2,000 *Salmonella* cultures from humans typed in the New York Center. Felsenfeld and Young (14) typed 6,802 *Salmonella* cultures from 500 outbreaks in North and South America from 1943 to 1948. The fact that gastro-enteritis is by far the most prevalent of *Salmonella* infections in man is further emphasized by these reports. More than half of the cultures on which clinical data were available were obtained from cases of gastro-enteritis.

SOURCES OF "SALMONELLA" GASTRO-ENTERITIS

There are two opportunities for food to serve as a means of transmitting human *Salmonella* infections. Firstly, food is an excellent medium for transmission from the human carrier. Although the carrier state of *Salmonella* other than the human adapted strains (*Salmonella typhosa*, *S. paratyphi A*, and *S. paratyphi B*) is generally considered to be a temporary condition, their importance should not be overlooked. As a result of investigations in the New York *Salmonella* Center, Seligmann, Saphra, and Wassermann concluded that irrespective of

the adaptation of the *Salmonella* type, healthy persons are important vectors. From 1,000 positive cultures, 19.5 percent of the isolations were from healthy carriers, many of them food handlers to whom outbreaks were traced. Edwards, Bruner, and Moran (10) have found an even higher percentage of isolations from asymptomatic carriers, amounting to 30 percent. The author and Hardy (20) found that, of 745 *Salmonella* isolations from routine fecal specimens in Florida, 46 percent were from patients with known histories who were food handlers and apparently were normal.

Permanent carriers of the *Salmonella* types that are not specifically adapted to man but that frequently cause food poisoning seldom are found, but such carriers do exist. Rubenstein, Feemster, and Smith (40) reported two permanent carriers of *Salmonella oranienburg* and one of *Salmonella derby*. In 1945, D'Albora, Ingegno, and Edson (1) found a person who was a chronic carrier of *Salmonella montevideo*. In this laboratory, *S. montevideo* was isolated intermittently for 9 months from a 1-year-old child after it had recovered from a severe diarrhea.

Secondly, the great hordes of animals associated with man serve as an excellent source of *Salmonella* food poisoning, through food, or by direct association. According to Edwards, Bruner, and Moran (10), fowls are the largest single reservoir of *Salmonella* in this country. These authors found a larger number of *Salmonella* types in fowl than in any other species except man. Hinshaw and McNeil (25) report that 58 types have been isolated from avian species. In 1944, they reported (26) that of 47 types found in birds, 41 had been found in man also. Further, they observed cases of gastro-enteritis among attendants on poultry farms caused by contact with acute outbreaks in poultry. Until recent years *S. pullorum* usually was considered as nonpathogenic for man. Now this type also has been incriminated as a cause of one large outbreak of food poisoning (38) and several sporadic cases (12,32). In Florida, *S. pullorum* has been isolated from the feces of a 12-year-old child ill with gastro-enteritis, and from a hospitalized adult with a mild enteric fever.

Reports of raw, frozen, or dried eggs as being sources of *Salmonella* outbreaks appear frequently. Such an outbreak attributed to raw eggs which contained *S. montevideo* was reported by Watt (47). Schneider (43) isolated *Salmonella tennessee* from frozen whole eggs and from powdered eggs.

Extensive studies on the occurrence of *Salmo-*

nella types in dried-egg powder have been reported by Solowey, *et al.*, (46) Gibbons and Moore (23), and British investigators (36). The British workers attributed their marked increase of *Salmonella* infections, especially of the types common in this country, to the consumption of American egg powder. Garrod and McIlroy (21) describe an outbreak of *S. typhi-murium* due to infected duck eggs.

McCullough and Eisele (35) were able to produce clinical salmonellosis in 32 human volunteers by experimental infection with strains of *Salmonella meleagridis* and *Salmonella anatum* derived from spray-dried whole egg.

As observed by Hinshaw, McNeil, and Taylor (26), salmonellae invade many hosts. Not only are chickens and ducks susceptible, but also turkeys, pigeons, quail, pheasants, and many other species of birds. In a search of infected poultry ranches for other animal reservoirs of *Salmonella*, Hinshaw and McNeil (27) isolated *S. typhi-murium* from snakes, cats, and house flies. The transmission of *Salmonella* by flies has also been reported by Ostrolenk and Welch (39).

The prevalence of *Salmonella* in swine and cattle, the major sources of meat for man, is well known. In a recent study of 2,788 *Salmonella* cultures derived from animals other than man or fowls, Bruner and Moran (4) found that 76 percent, including 37 types, came from swine and 15 types came from 69 outbreaks in cattle. Many of the cultures from hogs were isolated from the enteric lymph glands of normal animals. The occurrence of *Salmonella* in the lymph glands of normal hogs was first demonstrated by Hormaeche and Salsamendi (31), and Rubin, Scherago, and Weaver (41). This work stimulated a study by Cherry, Scherago, and Weaver (6) of the occurrence of *Salmonella* in retail meat products; more recently a similar study of market meat, eggs, and milk has been conducted by Felsenfeld, Young, and Yoshimura (15). As would be expected, in both studies a higher percentage of *Salmonella* was isolated from pork samples than from beef samples. Inadequately cooked pork products containing *Salmonella* frequently are cited in outbreaks of food poisoning. Hauser, Treuting, and Breiffel (24) describe an outbreak due to *Salmonella berta* in sausage.

A survey on salmonellosis in domestic animals in England was made by Smith and Buxton (45). These investigators examined the feces of healthy adult cattle, sheep, horses, hogs, goats, chickens, turkeys, ducks, and geese. They found that the *Salmonella* types isolated from these healthy ani-

mals were, with the possible exception of *S. pul-lorum*, those that are commonly incriminated in outbreaks of food poisoning in man and that frequently cause clinical disease in domestic animals. They emphasize the importance of these symptomless fecal carriers from both the public health and the agricultural points of view.

Extensive investigations on salmonellosis in cattle in Great Britain have been made by Field (16-18). The author points out the possibilities of meat, meat products, or milk of bovine origin being sources of food poisoning; and he recommends strict attention to the hygiene of milk and milk-product production, and to hygiene in slaughterhouses. He further recommends adequate ante- and post-mortem examination of emergency-slaughtered cattle to prevent distribution of contaminated meat products.

In a recent review, Koller (34) observed that the possibility of complete eradication of *Salmonella* from livestock was hopeless, since the best veterinary meat inspection is not sufficient to identify all cattle and swine harboring *Salmonella* and thus to prevent transmission to humans. He recommends general hygienic measures for animals and rigid hygienic control in the meat industry. He further emphasizes the need for pasteurization of milk and meat products, and for regular medical inspection of food handlers and of sanitary facilities in food industries.

Only recently concerted attention has been given to *Salmonella* infections in domestic pets. The high incidence of *Salmonella* and the variety of types in dogs obtained in this laboratory (19) suggest that these animals may be an excellent source of infection for man. Probably cats have received even less attention than dogs. The isolation of *Salmonella braenderup* from a case of enteritis in a man and from his cat was reported by Kauffmann and Henningsen (33). Salsamendi (42) obtained *S. anatum* from cats, and Mera (37) isolated *S. paratyphi A* from the animal. Watt, *et al.* (48) and Edwards, *et al.* (13) report the isolation of six new *Salmonella* types from normal cats.

There are few animal species that have not been found to harbor *Salmonella*. Rats and mice (22,49) are frequent suspects in the investigation of outbreaks in public food establishments. Horses and sheep less frequently are involved as a source of *Salmonella* infection in man (11).

After reviewing some of the factors responsible for the transmission of *Salmonella* food poisoning, the application of control measures recommended

by Buonomini(5) seems a most desirable procedure. These steps include: (1) provision of a pure water supply; (2) proper removal and disposal of sewage; (3) control of milk supplies, and pasteurization; (4) veterinary control of animals; (5) bacteriological control of foods; (6) systematic destruction of rats and mice; (7) systematic destruction of flies and other insects; and (8) control of healthy carriers with compulsory reporting of cases. A recent memorandum on food poisoning issued by the British Ministry of Health(3) further emphasized the necessity for adequate field and laboratory investigations during outbreaks.

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Have you read...?

BACILLARY DYSENTERY

Bacillary dysentery (Editorial). J.A.M.A. 146 (16): 1514-1515 (1951). This is a brief discussion of the "disease that has been widely distributed throughout the world from time immemorial." It is pointed out that, "The disease has been traced from the acute to the chronic phase in the same human being, so that the chronic type is now better understood."

MALARIA

Eradication of malaria (Editorial). J.A.M.A. 146(17): 1599 (1951). This editorial points out that emphasis is now on Nation-wide malaria eradication rather than on control of malaria, as in the past. Some of the methods used to reduce endemic malaria to its present low level are cited.

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